IRELAND'S GREAT DEPRESSION

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Research Department
Working Paper 0510

October 2005

FEDERAL RESERVE BANK OF DALLAS

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Abstract: We argue that Ireland experienced a great depression in the 1980s comparable in severity to the better known and more studied depression episodes of the interwar period. Using the business cycle accounting framework of Chari, Kehoe and McGrattan (2005), we examine the factors that lead to the depression and the subsequent recovery in the 1990s. We calculate efficiency, labor, investment and government wedges, and evaluate the contribution of each to the downturn and subsequent recovery. We find that the efficiency wedge on its own can account for a significant portion of the downturn, but predicts a stronger recovery in output. The labor wedge also helps account for what happened during the depression episode. We also find that the investment wedge played no role in the depression.

JEL Codes: **E65, O41, O52**

[*]Prepared for the October 2005 festschrift conference in honor of Brendan Walsh. An earlier version of this paper was presented to the Dublin Economics Workshop Annual Economic Policy Conference in Kenmare in 2003 and to the Society for Economic Dynamics meeting in Paris in June 2003. The views expressed are those of the authors and do not necessarily reflect the views of the Board of Governors, the Federal Reserve Bank of Dallas or the Federal Reserve System. We thank Erasmus Kersting for research assistance, and Brian Keegan of The Institute of Taxation for assistance with the Irish tax code. We are grateful to Adele Bergin of the ESRI for providing access to the ESRI databank.
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1. Introduction

Ireland's impressive economic performance during the 1990s attracted global attention. The facts are by now well known. Per capita GDP increased from around 60 percent of the EU average at the beginning of the decade to more than 100 percent by the end of the decade. Rapid GDP growth was accompanied by dramatic declines in the unemployment rate. Ireland went from having one of the highest unemployment rates in the EU in the middle of the 1980s to one of the lowest by the turn of the century. Between 1987 and 2000, non-agricultural employment in Ireland increased about 45 percent, with almost all of the jobs being generated in the private sector. The most dramatic job gains came after 1994: from 1994 to 2000, approximately half a million new jobs were generated (almost all of them in the business sector), compared with **zero** net employment creation during the first 70 years of the state's existence.[1] Ireland's performance during the second half of the 1990s was so impressive that it came to be referred to as the "Celtic Tiger."

Many reasons have been put forward for the impressive performance of the Irish economy during the 1990s, with particular attention being paid to the favorable corporate income tax regime, the availability of a high-skilled low wage workforce, and tariff-free access to the markets of the European Union. Between 1986 and 1997, the top marginal rate of personal income tax fell by some 10 percentage points, while the basic rate of corporate income tax fell by 12 percentage points. Low rates of corporate taxation, along with free access to the European market, made Ireland an attractive location for US firms seeking access to the European market. According to a recent OECD study, Ireland has fewer restrictions on FDI than any other OECD country except the UK.[2] Furthermore, the reduction in restrictions since 1980 has been greater than in almost any other OECD country. And there has been an extraordinary influx of foreign firms over the past decade and a half, with most major US technology companies having important production plants in Ireland. A component of the FDI story is that the granting of free access to second-level education in the late 1960s meant that the country had a labor force with the

[1] According to Meenan (1970), the number of people "gainfully employed" in 1926 was 1.304 million. In 1961, the number was 1.052 million. According to recent OECD data total employment did not exceed the level of 1926 until 1996.
[2] See OECD *Economic Outlook* No. 73, 2003.

appropriate skill mix for foreign investors. Walsh (2000) argues that all of the factors mentioned above played an important role in creating the Celtic Tiger, and further that "we cannot establish the relative importance of each." (Walsh, 2000, p. x) The papers in the volume edited by Barry (1999) are a represent major attempts to account for what happened and why.

A somewhat different perspective on the 1990s boom is provided by Honohan and Walsh (2003). The essence of the Honohan and Walsh thesis is that the boom of the 1990s was nothing more than delayed convergence. We summarize our interpretation of the Honohan and Walsh in **Figure 1**. Honohan and Walsh identify 1973 as a key date in Irish macroeconomic history, noting that "…in 1973 an optimist could – and some did – foresee a steady convergence in living standards to reach those of the United Kingdom and other advanced European economies within a generation…Indeed, the situation at the end of the twentieth century can be seen as the fulfillment of that prediction." (Honohan and Walsh, 2002, p.4) They go on to note "The whole period since 1973 thus appears as a long business cycle, with a deep and prolonged trough in the first half of the 1980s and a climacteric around end-century." (Honohan and Walsh, 2002, p.7) **Figure 1** shows the deviation of (the log of) GDP per head of working age (15-64) population (measured in millions of 1995 euro) from a deterministic trend fitted to the same series over the 1960-73 period.[3] GDP per head of the working age population grew at an average annual rate of 3.6 percent over the period from 1960 to 1973. In 1973, GDP per head of working age population was 0.8 of one percent above trend. Growth slowed substantially following the first oil price shock in 1973, and was further derailed after a brief growth spurt in 1977 and 1978 by the second oil shock in 1979.

The severity and duration of the downturn that followed the two oil shocks qualifies it as a "great depression" according to Kehoe and Prescott (2002). Kehoe and Prescott propose two criteria for classifying a cyclical episode as a great depression:

1. First, the downturn must be sufficiently <u>severe</u>. Kehoe and Prescott adopt a working definition of severity as a decline of at least 20 percent below trend.

[3] See Data Appendix for data sources and variable definitions.

2. Second, the decline must be rapid. Kehoe and Prescott adopt a working definition of rapidity as a decline of at least 15 percent below trend within the first decade of the episode.

We see that the Irish episode satisfies both of these criteria. By 1983, GDP per head of working age population was 15.5 percent below trend. By 1988, GDP per head of working age population was 22.3 percent below trend, and in 1993 bottomed out at 23.5 percent below trend. The rapid growth of the 1990s brought output back to its trend level by 2002. We should note here that the Kehoe and Prescott definition of a depression does not require that the economy return to its pre-depression trend path. They allow for the possibility that changes in institutions during the course of a depression may permanently lower the level of total factor productivity. This does seem to have been the case in Ireland. While the Irish episode does not quite match the US Great Depression in severity (Cole and Ohanian (1999) report that output in the US was only 61.7 percent of its trend level at the trough of the Great Depression in 1933), it surpasses it in length. Indeed, none of the depression episodes studied in the Kehoe and Prescott volume are as long as the near 30 cycle that Ireland experienced.

We should also note here that Kehoe and Prescott define trend in terms of the long run growth rate of the US economy. Over the twentieth century, GDP per head of working age population has grown at an average annual rate of about 2%. The choice of this benchmark is justified in terms of the US representing the frontier of what is available to all countries, absent "barriers to riches." Use of the 2% figure is probably reasonable for countries that were relatively rich at the beginning of their great depression episodes (such as the New Zealand and Switzerland episodes studied by Kehoe and Ruhl (2003, 2005)). However, Ireland was arguably still in the process of converging to the frontier when its great depression episode began. **Figure 2** shows Ireland's per capita GDP relative to the US since 1920. Note that Ireland remained pretty constant at about 42 percent of the US level throughout the 1950s. The opening of the economy in the late 1950s and early 1960s arguably put the economy on a convergence trajectory. This is a key part of the story of Honohan and Walsh, and we will assume a high rate of trend growth in the quantitative exercises below.

Viewed from a great depression perspective, what happened during the Celtic Tiger boom years of the 1990s was simply a recovery from a very severe downturn. There is a well documented and seemingly robust relationship between the severity of downturns and the strength of the subsequent recoveries. Milton Friedman (1969) was one of the first to show that, while the strength of expansions bears little relation to the severity of the subsequent contractions, the severity of a contraction does seem to correlate with the strength of subsequent expansions. Specifically, the more severe the recession, the stronger the subsequent recovery. Wynne and Balke (1992) and Balke and Wynne (1996) showed further using data on industrial production and the NBER's chronology of US business cycles that what matters most is not the depth or length of a recession, but the cumulative output loss, and that most of the impact was in the first twelve months of the recovery.

The basic neoclassical growth model provides a useful framework for thinking about what happened in Ireland over the past 30 years, and quantifying the relative importance of various factors identified by previous authors. In recent years a number of authors have sought to understand various depression and recovery episodes using this model. Cole and Ohanian (1999) is a pioneering contribution in this regard. They explored the implications of the neoclassical model for what happened in the United States during the Great Depression of 1929-33. They found that the basic model driven by productivity shocks can account for much of the severity of the decline in activity during the Depression, but has trouble accounting for what happened during the recovery. In subsequent research, Cole and Ohanian (2001) show that New Deal cartelization policies that limited competition and enhanced the bargaining power of unions can account for a significant fraction (about half) of the sluggish recovery from the 1929-33 downturn.

More recently Kehoe and Prescott (2002) edited a special issue of *Review of Economic Dynamics* devoted to trying to account for various great depressions in different countries using this model. In addition to examining the interwar depressions in Canada, the US, the UK, France, Italy and Germany, contributors to the volume also considered the more recent depression experiences of Argentina, Mexico, Chile and Japan. While the factors driving the downturns and recoveries differed from case to case (for example, generous unemployment benefits in the case of the UK, trade restrictions in the case of Italy, a deceleration of TFP in the case of Japan), the neoclassical growth model provides a unifying framework for thinking about the various depression episodes. Prescott (2002) used the basic model to account for differences in economic performance around the world. Prescott finds that France's low level of output per capita relative to the United States can be accounted for by the greater (tax) distortion of the tradeoff between consumption and leisure. Japan's depressed level of activity reflects less efficient production.

The power of this model to account for observed phenomena is clear. And if further justification were needed, we note Honohan and Walsh's observation that "…to the extent that the whole period represents a single observation or cycle, it limits the kind of econometric work that can be done on the broad time series characteristics…" (Honohan and Walsh, 2002, 11). This makes the neoclassical growth model an ideal econometric tool for studying this episode.

Wedges

In what follows we will use this model to do a basic business-cycle accounting exercise to illustrate the power of the neoclassical model to account for what happened in Ireland between 1973 and 2002. We will do this by estimating various "wedges" that could contribute to the downturn and subsequent recovery, and quantify the relative importance of each.

To understand what we mean by wedges, consider the basic labor market efficiency condition that in equilibrium the marginal rate of substation between consumption and leisure (MRS) will be equated to the (after tax) marginal product of labor ($(1-\tau)MPL$):

$$MRS = (1-\tau)MPL \tag{1}$$

As Hall (1997) and Mulligan (2000) point out, almost any reasonable macroeconomic model will imply an equilibrium condition of this sort. The wedge term, $(1-\tau)$, could be a tax on labor income, but could also reflect taxes on consumption, or other labor or product market distortions.

For example, if all taxes are levied on consumption at the rate τ^C and there are no labor income taxes, it is straightforward to show that in equilibrium

$$MRS = \left(\frac{1}{1+\tau^C}\right) MPL \tag{2}$$

which can be rewritten in the form of the labor market equilibrium condition by defining $\tau = \tau^C / \left(1+\tau^C\right)$. With both consumption and labor income taxes, at the rates τ^C and τ^L similar manipulations will give us the basic equilibrium condition with $\tau = (\tau^C - \tau^L)/(1+\tau^C)$.

As another example, consider an economy where final output is produced using a finite number of intermediate inputs that are not perfect substitutes for one another.[4] These intermediate goods are produced using capital and labor via a standard constant-returns-to-scale technology. Some algebra shows that in such an economy the labor market equilibrium condition will be of the form

$$MRS = \left(1 - \frac{1}{e}\right) MPL \tag{3}$$

where $e(n) \equiv \varepsilon - (\varepsilon - 1)/n$, and $\varepsilon > 1$ denotes the elasticity of substitution between various intermediate goods in producing final output, and n denotes the number of intermediate goods producers. Government policy that restricts entry into the intermediate goods producing sector will keep n below its optimal level. Elimination of restrictions on entry will allow n to rise to its equilibrium level, which will be reflected in a decline in the wedge, since $e'(n) > 0$.

Hall (1997) and Mulligan (2002) construct measures of this wedge and examine its ability to account for employment fluctuations in the US. Hall interprets his estimate of the wedge as a shock to preferences (the marginal rate of substitution between consumption and leisure), and finds that it accounts for a large fraction of the movements in hours in the US, with technology shocks playing only a minor role. Mulligan (2002) constructs time series for the wedge back to the nineteenth century, and finds that it correlates well with marginal tax rates at low frequencies.

[4] Foe more detail on this example, see Wu and Zhang (2000).

However, the labor-leisure or labor-consumption margin is not the only one that can be distorted by government policy. Regulation and taxation may also distort intertemporal margins, the willingness and ability of households and firms to substitute intertemporally. Government policy may also cause the economy to produce off the production possibility frontier. Wedges may also arise due to frictions of one sort or another that are due to factors other than government policy.

Chari, Kehoe and McGrattan (2005) propose using the standard neoclassical growth model to measure these wedges or distortions and quantify the relative importance of each in accounting for fluctuations in economic activity. Specifically, they start with prototypical neoclassical economy where households have preferences defined over per capita consumption, C, and leisure, L:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, L_t) N_t \tag{4}$$

where β is the discount factor and N denotes population. Households maximize (4) subject to a budget constraint

$$C_t + (1+\tau_t^X) X_t = (1-\tau_t^H) w_t H_t + r_t K_t + T_t \tag{5}$$

where τ^X denotes the tax rate on purchases of new investment goods, X denotes purchases of new investment goods (again, in per capita terms), τ^H denotes the tax on labor income, w denotes the real wage, H denotes hours supplied to market production, r denotes the return in capital, K denotes capital available for production during the period (also per capita), and T denotes per capita transfer payments to or from the government. Households accumulate capital by means of a standard accumulation equation:

$$g_N K_{t+1} = (1-\delta) K_t + X_t \tag{6}$$

where g_N denotes the gross rate of growth of the population and δ denotes the depreciation rate. Households are endowed with one unit of time each period, so $L + H = 1$. Firms operate a technology for converting capital and labor inputs into final output and maximize

$$A_t F\left(K_t, Z_t H_t\right) - w_t H_t - r_t K_t \tag{7}$$

where technical progress is assumed to be labor augmenting at the gross rate g_Z: $Z_{t+1} = g_Z Z_t$.

The equilibrium of this prototypical economy is then given by the resource constraints

$$Y_t = C_t + X_t + G_t \tag{8}$$

$$L_t + H_t = 1 \tag{9}$$

where Y denotes per capita output and G denotes per capita government consumption, and

$$Y_t = A_t F(K_t, Z_t H_t) \tag{10}$$

$$\frac{U_L(C_t, L_t)}{U_C(C_t, L_t)} = (1 - \tau_t^H) A_t Z_t F_H(K_t, Z_t H_t) \tag{11}$$

$$(1 + \tau_t^X) U_C(C_t, L_t) = \beta E_t U_C(C_{t+1}, L_{t+1})[A_{t+1} F_K(K_{t+1}, Z_{t+1} H_{t+1}) + (1 - \delta)(1 + \tau_{t+1}^X)] \tag{12}$$

On the basis of the equations defining the equilibrium of this prototype model, Chari, Kehoe and McGrattan propose four measures of wedges or distortions: An efficiency wedge, defined as:

$$A_t = \frac{Y_t}{F(K_t, Z^t L_t)} \tag{13}$$

a labor wedge, defined as

$$(1 - \tau_t^H) = -\frac{U_C\left(C_t, 1 - H_t\right)}{U_L\left(C_t, 1 - H_t\right)} A_t Z^t F_H\left(K_t, Z^t H_t\right) \tag{14}$$

an investment wedge defined (implicitly) by the intertemporal efficiency condition

$$(1 + \tau_t^X) U_C\left(C_t, 1 - H_t\right) =$$
$$E_t \beta U_C\left(C_{t+1}, 1 - H_{t+1}\right)\left[A_{t+1} F_K\left(K_{t+1}, Z^{t+1} H_{t+1}\right) + (1 - \delta)(1 + \tau_{t+1}^X)\right] \tag{15}$$

and a government consumption wedge defined implicitly by the aggregate resource constraint (8).

It is clear that what is termed the efficiency wedge in this economy resembles total factor productivity, while the labor (or intratemporal) and investment wedges resemble taxes on labor income and investment. The government consumption wedge acts just like (unproductive) government spending in most macro models. However, as Chari, Kehoe and McGrattan (2005) show, the wedges in this prototype economy can reflect a much wider range of shocks or distortions than changes in productivity, taxes or government purchases.[5]

For the purposes of thinking about the applicability of the Chari, Kehoe and McGrattan business cycle accounting procedure to the Irish case, it is worth illustrating how various open economy models map into their prototype economy. Consider first the following standard small open economy model. Household preferences are given by

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, L_t) \tag{16}$$

where notation is as before and we abstract from population growth. The household's budget constraint is given by

$$C_t + X_t + J_t = F\left(K_t, H_t\right) + rB_t \tag{17}$$

where we have consolidated the firm's problem into the household problem. Notation is as before and we assume there is no government and no technical progress. J denotes purchases of foreign bonds (foreign investment) and rB denotes earnings on holdings of foreign capital, with r denoting the foreign (world) real interest rate and B denoting holdings of foreign assets. Foreign asset holdings evolve according to $B_{t+1} = B_t + J_t$. We assume that the economy is small in the sense that it takes the world real interest rate as given, and we further assume that $\beta(1+r) = 1$. The other constraints on the household's problem are as before. Net exports in this economy will be equal to $F\left(K_t, H_t\right) - C_t - X_t = J_t - rB_t$.

Compare this economy to a similar economy that is identical in all respects except that it is closed and there is a government that purchases some portion of final output, financing its purchases by means of lump sum taxes without having to resort to any form of distortionary taxation. The resource constraint in this economy is given by

$$C_t + X_t + G_t = F\left(K_t, H_t\right) \tag{18}$$

If we let the government consumption wedge in the closed economy be given by $G_t = F\left(K_t^{SOE}, H_t^{SOE}\right) - C_t^{SOE} - X_t^{SOE}$ where $(C^{SOE}, H^{SOE}, X^{SOE}, K^{SOE})$ denote equilibrium allocations in the small open economy, the allocations in the prototype closed

[5] Note that time varying taxes on consumption spending would distort both the intratemporal and intertemporal margins.

economy will be identical, since the first order conditions will be the same in the two economies. This is the sense in which net exports in the detailed small open economy map into the government consumption wedge in the prototype economy.

Consider next the following open economy example from Crucini and Kahn (2003). Consider a small open economy where households have preferences defined over a non-traded consumption-investment good, C_N, traded consumption goods, some of which are produced domestically, C_T, while others are imported, C_{T*}, and leisure as before. Households allocate time to the production of the nontraded good, H_N, the domestic tradable, H_T, material inputs (which are traded), H_M, and leisure, subject to the constraint $1 - L - H_N - H_T - H_M \geq 0$. Each good is produced by means of a Leontief technology combining materials inputs and a composite of capital and labor services, $F(K, H)$. Preferences are given by

$$E_0 \sum_{t=0}^{\infty} \beta^t (\log C_t + \kappa L_t) \tag{19}$$

where the composite consumption good $C = \left[b_N C_N^{-\gamma} + b_T C_T^{-\gamma} + b_{T*} C_{T*}^{-\gamma}\right]^{-1/\gamma}$.

The representative firm in this economy chooses inputs to maximize

$$Y_i - wH_i - rK_i - p_M M_i \tag{20}$$

subject to the production function, taking as given the prices of labor and capital services, w and r, and the price of intermediate inputs, p_M. With the fixed intermediate input given by $M_i = \theta Y_i$, we can rewrite this as

$$(1 - \theta p_M) Y_i - wH_i - rK_i \tag{21}$$

We assume that in addition to being a price taker in domestic factor markets, the representative firm is also a price taker in the world market for intermediate inputs. The domestic price of intermediate inputs (in terms of domestic output) is $p_M = (1 + \tau^M) p_M^*$ where p_M^* denotes the world price of material inputs and τ^M denotes the domestic ad valorem equivalent tariff on imports of intermediate goods.

The first order conditions for labor and capital are then

$$(1 - \theta p_M) F_K(K, H) = r \tag{22}$$

and

$$(1-\theta p_M)F_H(K,H) = w \tag{23}$$

Comparing these conditions with the comparable conditions in the prototype economy, it should be clear that fluctuations in the domestic tariff on imports of intermediate inputs or changes in the world price of these inputs will correspond to changes in the efficiency wedge in the prototype economy. What if the tariff were imposed on imports of final consumption goods rather than intermediate inputs? The tariff will again show up in the efficiency wedge, but will not result in an observable labor wedge, since it will simply lower the real wage and the marginal rate of substitution between labor and consumption will be equal to the new marginal product of labor.

Measurement

To measure the various wedges we need to specify functional forms for preferences and production, and assign values to the model's parameters. We employ the standard Cobb-Douglas specification of the production function $F(K,ZH) = K^{\alpha}(ZH)^{1-\alpha}$, and assume that capital's share is α = 0.35. We assume that the utility function take the log form $U(C,L) = \log C + \psi \log L$ and that the time allocation parameter ψ = 1.5. We set the discount factor β = 0.97 and assume δ = 0.08. Our specifications for preferences and technology are the same as those employed by Chari, Kehoe and McGrattan (2005) in their study of US business cycles, and also by Chakraborty (2005) and Kobayashi and Inaba (2005) in their studies of Japanese cycles. The trend rates of growth, g_Z and g_N, are set equal to 1.036 and 1.006 respectively.[6]

Give these estimates of the various wedges, how well can we account for what happened in Ireland in the 1970s, 1980s and 1990s? More specifically, which of these

[6] The choice of values for most of these parameters is relatively uncontroversial. If we try to estimate α using data from OECD national accounts as the ratio of compensation of employees to GDP, we would get a value for α of around 0.55. However, such an estimate may underestimate labor income in small firms, and as Gollin (2002) has shown, when properly measured, the share of labor in national income ranges between 0.65 and 0.80 in most countries, implying a range of values for α of between 0.35 and 0.2. We also assume a relatively high rate of trend productivity growth. Recall that we estimate that the trend rate of growth of GDP per head of working age population during the 1960-73 period was 3.6 percent. Using data from the OECD Outlook database for the Irish business sector we estimate a trend rate of growth of TFP from 1970 to 2004 of 3.8 percent (the number is only slightly lower of we use a the higher value for α suggested by the OECD National Accounts. By way of comparison, Maddison (1995) (Table 3-13b) estimates that labor productivity grew at an average annual rate of 4.3 percent between 1950 and 1973, and 4.1 percent between 1973 and 1991.

wedges accounts for the long bust and boom that Ireland experienced? **Figure 3** shows our estimate of per capita GDP relative to trend (solid line), along with the movements in GDP predicted by each of the four wedges considered in isolation (dashed line), while **Figures 4** and **5** shows the predicted movements of the labor input and investment. By construction, the four wedges will account for all of the movements in GDP. We take 1973 as the peak year - in an earlier draft of this paper we took 1978 as the starting point. Our choice of 1973 as the starting point of the cyclical episode is motivated by our reading of Honohan and Walsh. GDP per head of working age population was less than 0.8 of percentage point from its (1960-73) trend that year.

Starting with the top left panel of **Figure 3**, we see that the efficiency wedge on its own can do a good job of accounting for the downturn in output from 1973 through 1983 or 1984. However, the efficiency wedge on its own would have predicted a bottoming out of GDP about 15 percent below trend in 1986, followed by a steady recovery that would have taken GDP back to trend by 1997. Note that the labor wedge in isolation would have predicted a more severe downturn in output than in fact occurred, with output dropping about 30 percent below trend by the late 1990s. Note also that the labor wedge in isolation does not generate the recovery that we see in the data from the mid 1990s forward. Finally, note that the government and investment wedges cannot account for the downturn and recovery. The government wedge would have predicted growth essentially along trend, while the investment wedge would have predicted a boom through the early 1980s, followed by a period of growth along essentially a higher path.

Given the amount of attention paid to the growth in employment during the 1990s in Ireland, we decided to examine the predictions of our model for the labor input. **Figure 4** shows the predictions of the prototype model for the labor input when we allow each of the wedges to vary in isolation. Note that we use a more comprehensive measure of the labor input than employment alone: we measure the labor input in terms of aggregate hours worked in the market economy relative to the total number of hours available (see Data Appendix for details of our definition.) By our measure, the total amount of effort supplied to market production in Ireland fell after 1973, and has still not fully recovered. Starting again at the top left panel, note now that the efficacy wedge in isolation would have predicted that labor would have remained close to its trend level rather than declining by more than 20 percent between 1973 and the early 1990s. The government wedge and investment wedge would both have predicted a surge in the labor input of varying degrees rather than the decline that was actually experienced. Only the labor wedge generates a decline in the labor input, albeit more severe than the actual decline.

Figure 5 shows the path of investment over the course of the depression and recovery along with the paths predicted by each of the wedges in isolation. Note that we estimate that investment was nearly 50 percent below trend by the early 1990s and was still well below trend in 2002.[7] The investment wedge in isolation would have generated a boom in investment, while the efficiency, labor and government wedges all generate declines in investment comparable to some degree to what we see in the data.

It is interesting to compare the results for the long cycle of the 1970s, 1980s and 1990s with a shorter cyclical episode that might be considered less pathological. The Irish economy experienced a downturn in the mid 1960s. GDP per head of working age population was essentially equal to its trend value in 1965 and then declined to about 3 percent below trend in 1966 before recovering to trend by 1969. **Figures 6, 7** and **8** repeat the exercise shown in **Figures 3, 4** and **5** for this shorter and milder cyclical episode. We now see that the efficiency wedges and the labor wedge both would have predicted a downturn in activity in 1966 and 1967. Note however that whereas the efficiency wedge then predicts a recovery in 1968 and 1969, the labor wedge predicts a persistent drop on output relative to trend. Indeed, the efficiency wedge on its own can effectively account for all of the 1965-68 cycle. The government and investment wedges would have generated growth above trend rather than downturns. When we look at the predictions for the labor input, we see that the efficiency, labor and government wedges all would have generated a decline in 1966 and 1967. The efficiency and government wedges have the labor input recovering by 1969, whereas the labor wedge generates a persistent decline in the labor input. And once again, the investment wedge generates movements in the wrong direction.

So one robust result from this exercise is that the investment wedge does not seem to matter for the behavior of output, investment and the labor input in either of the

[7] See Data Appendix for our definition of investment. We include purchases of consumer durables in our definition of investment and exclude tem from our measure of consumption.

cyclical episodes that we look at, in the sense that in both episodes the investment wedge acting in isolation would have predicted output growth above trend rather than below. This is similar to what Chari, Kehoe and McGrattan find for the Great Depression in the US and the 1982 downturn. They conclude that distortions manifested in the investment wedge played essentially no role in the Great Depression, and at best a modest role in the 1982 recession. The only other business cycle accounting exercises of this sort that we are aware of, those of Chakraborty (2005) and Kobayashi and Inaba (2005) for Japan reach conflicting conclusions on the importance of the investment wedge in accounting for Japan's lost decade, with Chakraborty concluding that the investment wedge played a major role, while Kobayashi and Inaba conclude that labor market distortions may have been the main source of the decade long stagnation of economic activity. It is interesting that we can get so much action so to speak from the efficiency wedge in isolation. All of the mid 1960s cycle can be accounted for by movements in this wedge alone, as can a significant part of the long cycle of the 1970s, 1980s and 1990s.

It is worth pausing to consider how well the wedges match up with either direct or indirect measures of labor and product market distortions. While changes in tax rates are (at least in principle) amenable to direct measurement, changes in other factors that might impact the size of these wedges, such as labor and product market regulation, are more difficult to measure. Such measures as do exist, such as those from the OECD's regulatory reform project, typically do not have a very rich time series dimension. A more compelling case for taking these (labor) wedge estimates seriously is given by comparing the series with direct measures of marginal tax rates. There were significant changes in personal income taxes in Ireland during the 30-year period we look at here. OECD data show income tax payments (plus employee contributions to social insurance) falling from 29.2 percent of gross wages in 1995 for single persons without children to 16.9 percent in 2001. (By comparison over the same period the tax burden went from 25.8 percent to 24.6 percent in the US.) In 1980, the top rate of income tax was 60 percent. There were five tax bands, with the top rate payable on income over £9,000. The top rate of taxation peaked at 65 percent in 1984/85 (payable on income over £10,000) and was steadily reduced to 44 percent in 2000.

Of course statutory tax rates are not necessarily the rates that households and businesses are concerned about when making decisions about how much to work, consume, save and invest. Rather, what we need is information on the marginal tax rates faced by economic agents. Unfortunately information of this sort is hard to come by. To date, no one has attempted to compute average marginal tax rates for Ireland using the methods of Barro and Sahasakul (1983, 1986). Mendoza, Razin and Tesar (1994) proposed a methodology for estimating average marginal tax rates for use in computational experiments using aggregate data from OECD National Accounts and Tax Statistics publications. The Mendoza, Razin and Tesar (hereinafter MRT) methodology has subsequently been adapted by the European Commission (Martinez-Mongay (2000)) and the OECD (Carey and Tchillinguirian (2000)) to produce alternative time series of tax rate for EU and OECD countries.

Figure 9 plots the wedge estimate computed above along with an estimate of the tax wedge based on the effective average tax rates in Martinez-Mongay (2000). The tax wedge is defined as $1-(1-\tilde{\tau}_t^L)/(1+\tilde{\tau}_t^C)$ where $\tilde{\tau}_t^C$ is Martinez-Mongay's estimate of the effective tax rate on consumption (his series CETR) and $\tilde{\tau}_t^L$ is his estimate of the effective tax rate on labor income (his series LETR). Note that the increase in the labor wedge in the late 1970s and early 1980s is accompanied by an increase in the tax wedge.[8] The two series are highly correlated with one another (correlation coefficient of 0.97). However, if we look at the movement in the two series relative to their levels in 1973, we find a much bigger increase in the estimated intratemporal tax wedge than we do in the intratemporal tax wedge.

Conclusions

We argue that Ireland experienced a downturn in economic activity in the 1980s that was comparable to the Great Depression of the interwar period. We use the business cycle accounting approach of Chari Kehoe and McGrattan (2005) to study the episode and determine which wedges played the dominant role in the downturn and recovery. For the sake of comparison we also look at the milder downturn that the Irish economy

[8] Note that the Figure would look much the same if we were to replace our estimate of the tax wedge with Martinez-Mongay's tax wedge on labor or tax wedge on employed labor.

experienced during the mid 1960s. We find that in the great depression episode, the government and investment wedges in isolation would have predicted growth above trend, rather than the severe downturn that was actually observed. The efficiency wedge in isolation can account for much of the decline in output during the first decade of the depression, and also generates a recovery, albeit not as strong as the recovery observed in the data. The labor wedge acting in isolation would also have generated a severe downturn, but no recovery. In terms of accounting for the change in the labor input, only the labor wedge generates movements in the right direction.

We view the results in this paper as a first step towards a quantitative explanation of what happened in Ireland during the 1970s, 1980s and 1990s. Regardless of whether the output decline satisfies the technical definition of a great depression as proposed by Kehoe and Prescott, there is no doubt that the downturn was severe, and that it is useful to try to explain the bust and boom as a single cyclical episode. Our study suggests many avenues for future research. To begin with, it is clear that Ireland was still engaged in a process of catch up in 1973 when the economy went into recession. It would also be useful to repeat the accounting exercise undertaken above to take account of the fact that Ireland was on a transitional growth path in 1973 when the downturn began, and see how robust our conclusions would be. Finally, it would be worthwhile investigating how well a basic extension of the model employed here can account for Ireland's convergence experience over the past four decades or so.

Data Appendix

Per capita output

≡ (GDP – Indirect taxes + Services from consumer durables + Depreciation from consumer durables) / Working age population

GDP = GDP in constant market prices, millions of 1995 euro. Source: ESRI databank, series GDP.

Indirect taxes = Total indirect taxes in constant prices, millions of 1995 euro. Source: ESRI databank, series TRE.

Services from consumer durables = Assumed equal to 4 percent of the estimated stock of consumer durables. (Same as Chari, Kehoe & McGrattan (2005)).

Stock of consumer durables = Estimated by cumulating the series CD (consumer spending on durables, millions of 1995 euro) from ESRI databank, with assumed annual depreciation rate of 16.5 percent. We obtain a starting value for the durables stock series by assuming that all purchases of consumer durables in 1953 were for replacement purposes. Note: Fraumeni (1997) reports depreciation rates used by the US Bureau of Economic Analysis to measure the stock of consumer durables that range from 11.79 percent (for furniture) to 61.77 percent for tires, tubes accessories and other parts. The 16.5 percent depreciation rate is used for several categories of durables.

Depreciation from consumer durables = Assumed equal to 16.5 percent of stock of consumer durables outstanding at the end of the previous year.

Working age population = Population aged 15-64, thousands. Source: ESRI databank, series N1564.

Per capita labor input

≡ (Annual hours worked per person employed × Total employment / Working age population) / (50 weeks ×100 hours per week)

Annual hours worked per person employed = Series Annual hours worked per person employed from Groningen Growth and Development Centre and The Conference Board, Total Economy Database, January 2005, http://www.ggdc.net

Total employment = Total employment, thousands. Source: ESRI databank, series LTOT.

Working age population = Population aged 15-64, thousands. Source: ESRI databank, series N1564.

Per capita consumption

≡ (Consumption of nondurables and services – Sales tax × (1 – Share of consumer durables in total consumer spending) + Service flow from consumer durables + Net exports)/Working age population

Consumption of nondurables and services = Consumption of nondurables and services in constant prices, millions of 1995 euro. Source: ESRI databank, series CND+CS.

Service flow from stock of consumer durables = Assumed equal to 4 percent of the estimated stock of consumer durables. (Same as Chari, Kehoe & McGrattan (2005)).

Working age population = Population aged 15-64, thousands. Source: ESRI databank, series N1564.

Per capita investment

≡ (Gross fixed investment + Private inventories + Personal consumption expenditure on durables – Sales tax × Share of consumer durables in total consumer spending) / Working age population

Gross fixed investment = Gross domestic capital formation, millions of 1995 euro. Source: ESRI databank, series ITOT.

Private inventories = Total value of physical changes in stocks, millions of 1995 euro. Source: ESRI database, series STDL.

Personal consumption expenditure on durables = Consumption of durables including transportation equipment, millions of 1995 euro. Source: ESRI databank, series CD.

Share of consumer durables in total consumer spending = CDV/(CDV+CNDV+CSV), where CDV = consumer spending on durables (millions of euro), CNDV = consumer spending on nondurables (millions of euro), and CSV = consumer spending on services (millions of euro), all from ESRI databank.

Working age population = Population aged 15-64, thousands. Source: ESRI databank, series N1564.

Note: Chari, Kehoe & McGrattan (2005) include net factor payments from abroad (GNP-GDP) in their measure of investment. We opt to exclude them.

Per capita government

≡ (Government consumption + Net exports) / Working age population

Government consumption = Government expenditure on current goods and services in constant prices, millions of 1995 euro. Source: ESRI databank, series GCG.

Working age population = Population aged 15-64, thousands. Source: ESRI databank, series N1564.

Net exports = Net exports of goods and services in constant prices, millions of 1995 euro. Source: ESRI databank, series XGS-MGS.

Note: Chari, Kehoe & McGrattan (2005) include the trade balance in their measure of per capita government; Chakraborty (2005) includes the trade balance in her measure of per capita consumption.

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Figure 1
GDP per head of working age population relative to 1960-73 trend

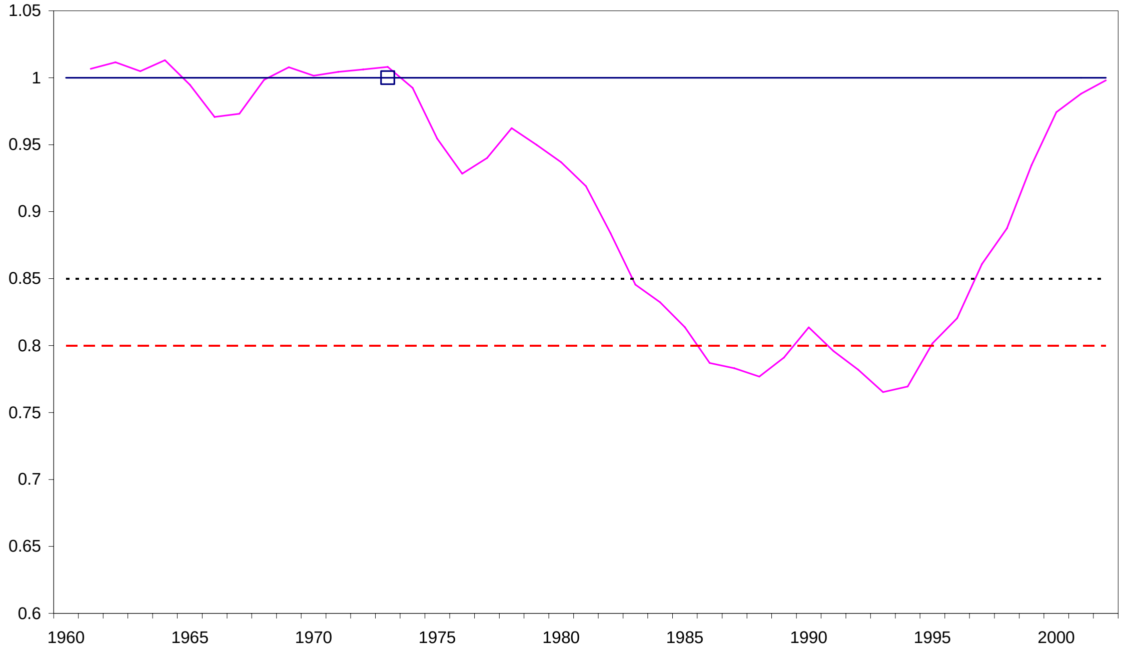

Figure 2
GDP per capita (working age population) Ireland relative to USA

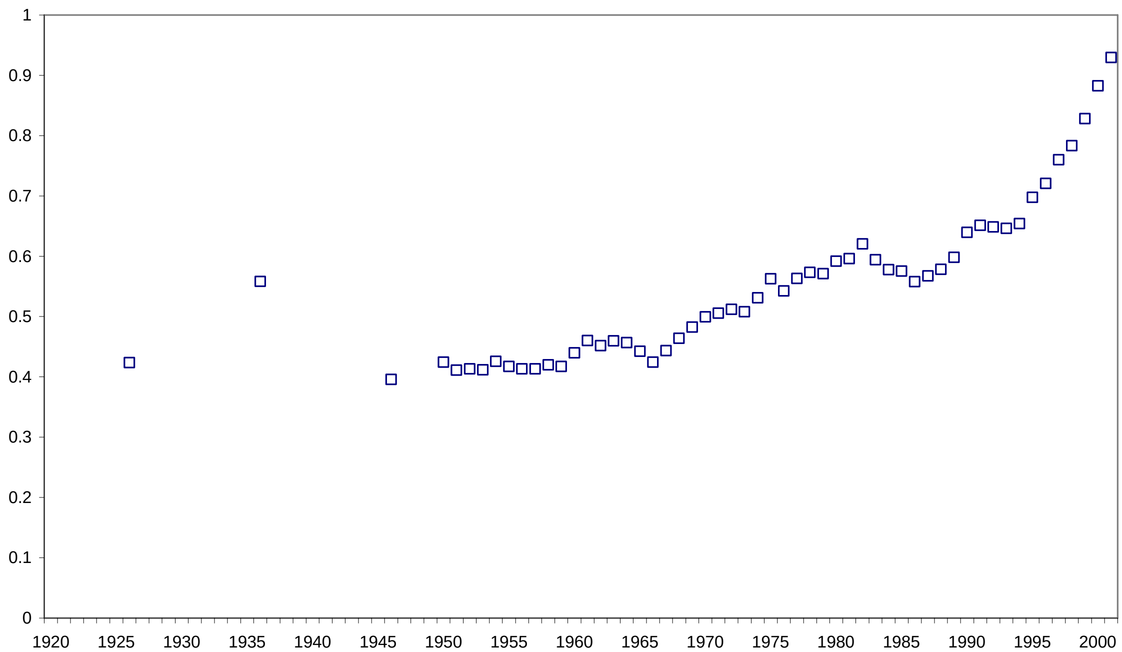

Figure 3

Output 1973-2002

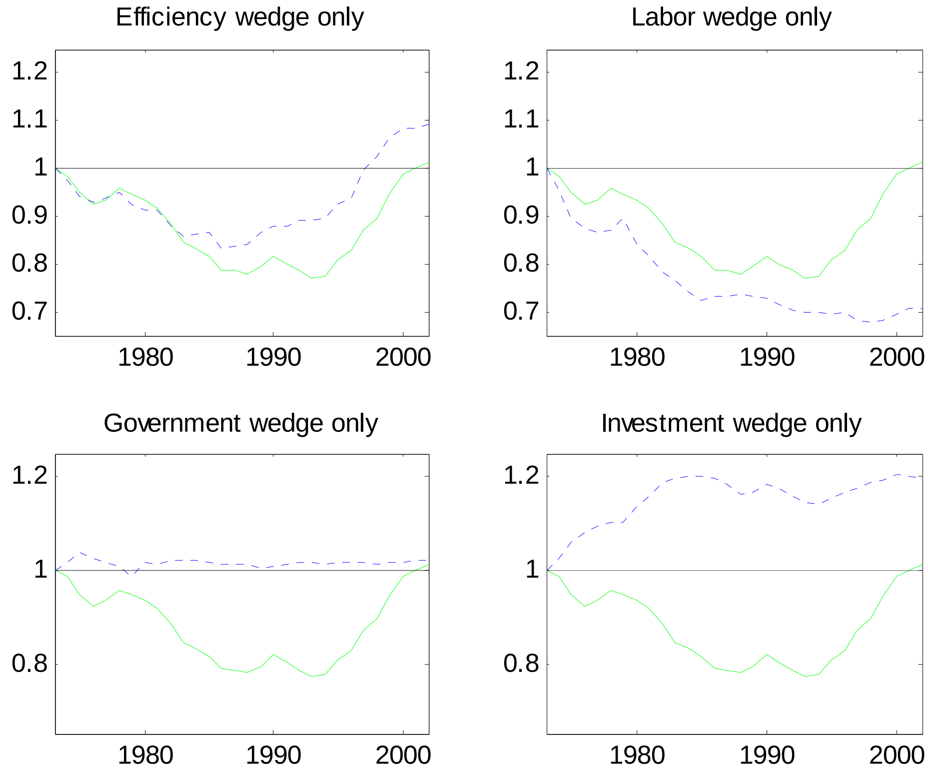

Figure 4

Labor input 1973-2002

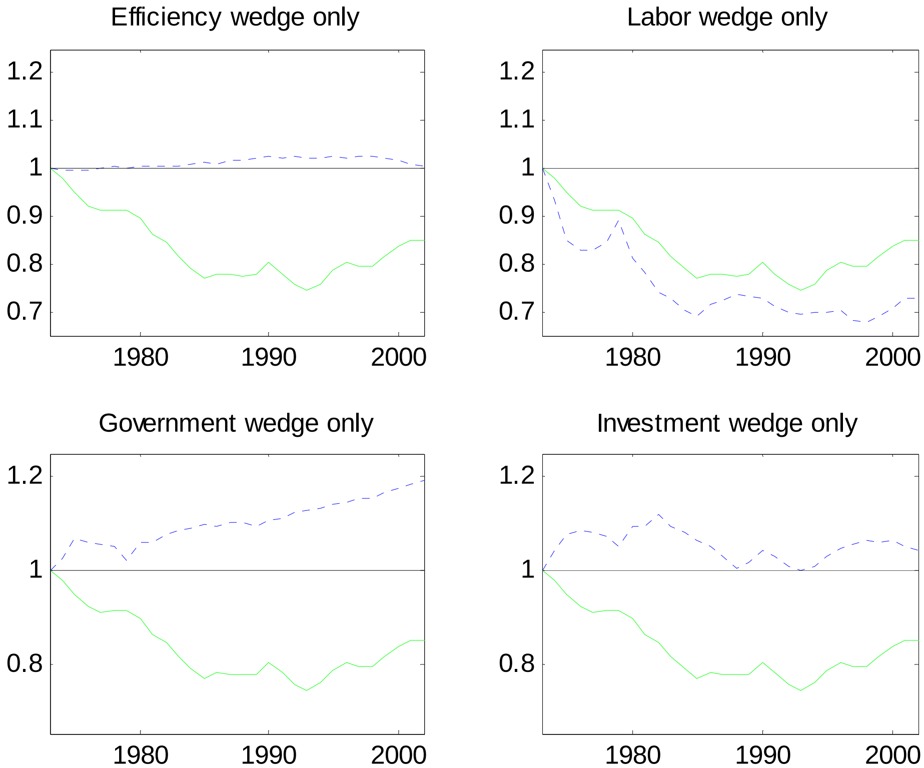

Figure 5

Investment 1973-2002

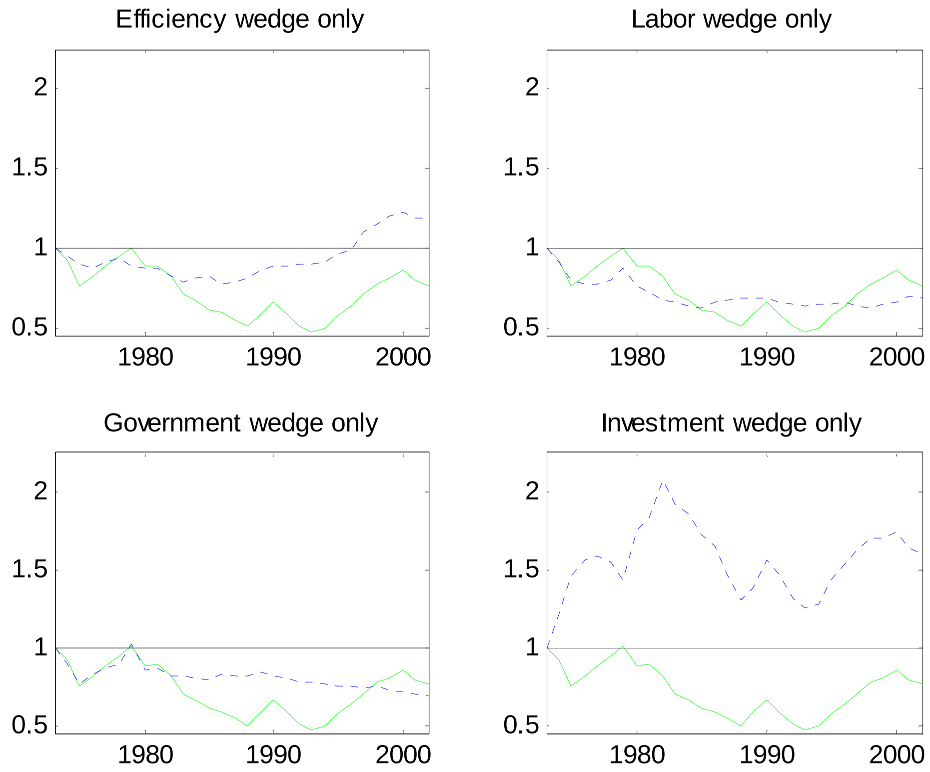

Figure 6

Output 1965-1969

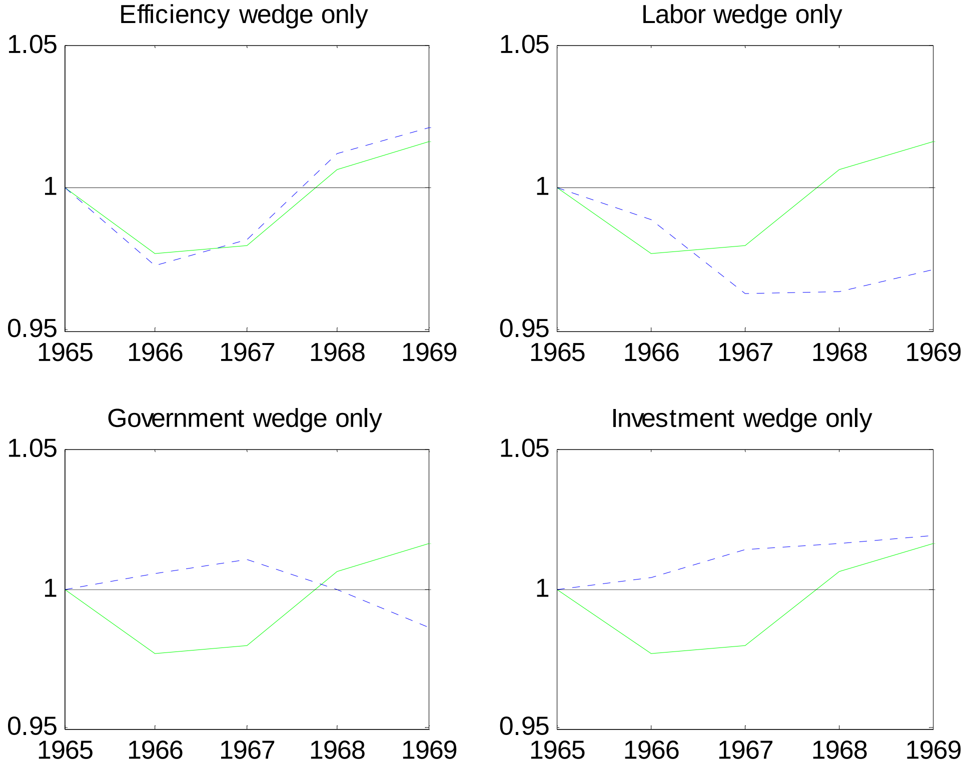

Figure 7

Labor input 1965-1969

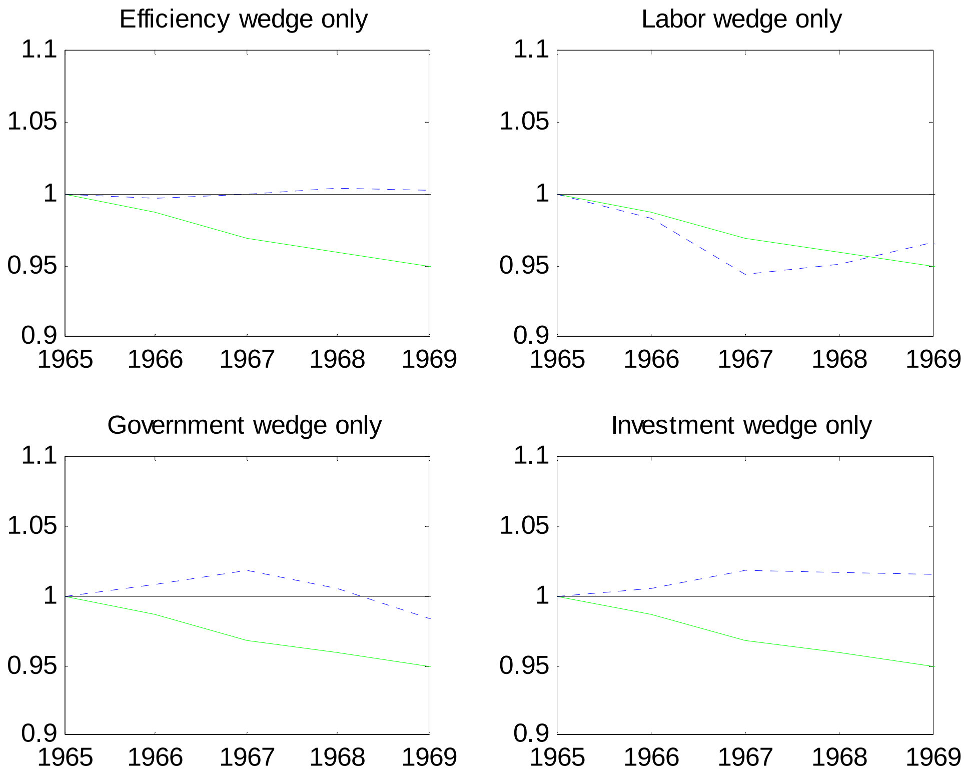

Figure 8

Investment 1965-1969

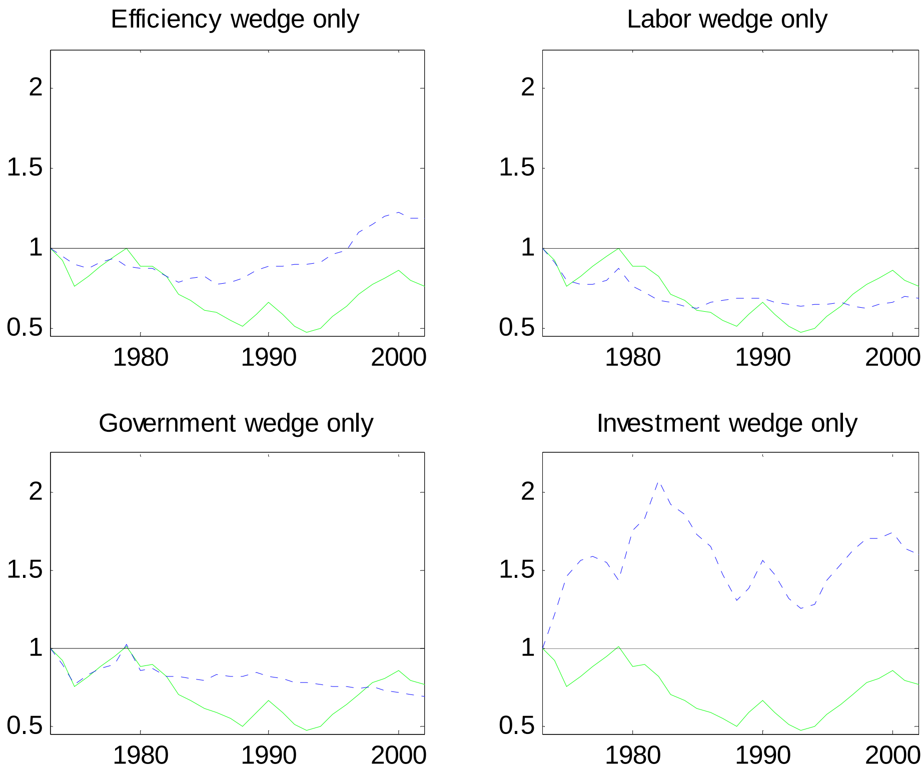

Figure 9
Estimated labor wedge and intratemporal tax wedge